11/16/00

A

Docket No. D5407-124

TRANSMITTAL OF FILING UNDER 37 C.F.R. 1.60(b)

This is a request for filing a continuation application of pending prior application Serial No. 09/239,879, filed on January 29, 1999, of **David G. Martin** and **Damien Patton** for their invention entitled **Downhole Connector for Production Tubing and Control Line and Method.**

1. Copies of the papers filed in prior application are attached are as follows:

13	pages of specification
06	pages of claims
01	page of abstract
06	sheets of informal drawings
02	pages of Combined Declaration and Power of Attorney
04	pages of Assignment Recordation
10	Sheets of formal drawings

I hereby verify that the attached papers are a true copy of what is shown in my records to be the papers filed in the above-identified prior application, including the oath or declaration originally filed.

2. The application is in the English language.

3. Included with this filing are an Information Disclosure Statement, PTO-1449, References Cited

4. This application discloses and claims only subject matter disclosed in the prior application whose particulars are set out above and the inventors in this application are the same.

CERTIFICATE OF MAILING UNDER 37 C.F.R. 1.10

I hereby certify that this Transmittal and the documents referred to as attached are being deposited with the United States Postal Service on **November 15, 2000**, in an envelope as "Express Mail Post Office to Addressee" Mailing Label Number **EL675616764US** addressed to the Assistant Commissioner of Patents, Washington, D.C. 20231.

Tracie Thigpen

5. The Assignment transferring rights of this application was recorded in the Patent Office on April 12, 1999, and is located at reel/frame number 9888/0395.

6. The fees should be calculated based on the number of claims originally filed.

7. The fee calculation for a regular application is as follows:

CLAIMS AS FILED

	Number Filed				Number Extra		Rate		Basic Fee (37 C.F.R. 1.16(a) $710
Total Claims	20	-	20	=	0	x	$18	=	0
Independent Claims	2	-	3	=	0	x	$80	=	0
Multiple Dependent Claims (if any)						+	$270		
Total Filling Fee									$710

8. Applicant is a other that a small entity.

9. Please charge Deposit Account No. 02-0429 the amount of $710 for the filing fee.

10. Please amend the specification by inserting, before the first line, the following sentence:

"This is a continuation of serial No. 09/239,879, filed on January 29, 1999."

11. The Commissioner is hereby authorized to charge the following additional fees by this paper and during the entire pendency of this application to Deposit Account No. 02-0429.

37 CFR 1.16 (filing fees)
37 CFR 1.16 (presentation of extra claims)
37 CFR 1.16(e) (surcharge for filing the basic filing fee and/or declaration on a date later than the filing date of the application).
37 CFR 1.17 (application processing fees)

12. Any overpayment is to be credited to Account No. 02-0429.

Respectfully submitted,

November 15, 2000

Richard T. Redano
Duane, Morris & Heckscher LLP
Registration No. 32,292
One Greenway Plaza, Suite 500
Houston, TX 77046
Telephone: (713) 552-9900
Facsimile: (713) 552-0109

TITLE: **DOWNHOLE CONNECTOR FOR PRODUCTION TUBING AND CONTROL LINE AND METHOD**

INVENTOR(S): DAVID G. MARTIN and DAMIEN PATTON

FIELD OF THE INVENTION

The field of this invention relates to the make-up of bottomhole assemblies on a tubing string, in conjunction with one or more control lines extending from the surface to the bottomhole assembly, and methods for assembly and test of such systems.

BACKGROUND OF THE INVENTION

Control lines have been attached to production tubing for operation of a variety of downhole components. Typically, the control line is assembled to the production tubing for running into the well together. If rigid tubing is used, the production string is made-up to position the bottomhole assembly at the desired depth, in conjunction with the attachment of the control line or control lines. It is only when the bottomhole assembly is fully positioned at the desired location downhole that the integrity of the control line can be first tested. Thus, when the bottomhole assembly is finally positioned and the control line is tested and a problem arises, the entire production string up to the bottomhole assembly must be removed from the wellbore in an effort to determine where leakage has occurred. What has been lacking in these techniques is the ability to primarily position the bottomhole assembly at the desired location and test portions of the control line adjacent to the bottomhole assembly while the bottomhole assembly is in position downhole. Accordingly, one of the objects of the present invention is to allow the flexibility of testing the portion of the control line where leakage is most likely to

occur, *i.e.*, adjacent the bottomhole assembly, where there are more joints in the system.

Another objective of the present invention is to facilitate the assembly of a control line system which extends from the surface down to the bottomhole assembly and back up again along the production tubing to the surface. With such a layout, fiber optic technology can be used to insert, through the control line, a fiber optic cable which extends from the surface to the bottomhole assembly and back to the surface. The positioning of such a fiber optic cable in the control line allows well conditions to be monitored from the surface on a real-time basis. Thus, when a particular zone produces water and its temperature drops, the fiber optic cable can sense this occurrence and its position so that surface personnel can take appropriate corrective action. The control line connection system can be used for numerous other applications. This with a fiber optic cable is just one example of how a U-shaped control line can be used.

The objective of the connector of the present invention is to also allow as many branch connections as necessary so that multiple downhole devices can be operated as required. The connector also allows, through the use of a running tool, an opportunity to not only test the control line adjacent the bottomhole assembly, but also to operate certain components of the bottomhole assembly through the running tool, whereupon the running tool can be removed and the remainder of the string connected to the bottomhole assembly through the unique connector. These and other advantages will become more apparent to those of ordinary skill in the art from a review of the description of the connector and the method below.

SUMMARY OF THE INVENTION

A connector is disclosed to facilitate the testing of a control line or lines adjacent a bottomhole assembly. A running tool is connected to a lower portion of

the connector which is, in turn, connected to the bottomhole assembly. The running tool allows testing of the control line adjacent the bottomhole assembly and thereafter, the operation of components of the bottomhole assembly. The running tool is removed and the upper portion of the string, including the mating portion of the connector at its lower end, is inserted into the wellbore. The connector components are self-aligning and lock to each other downhole to complete the production tubing and the control line tubing to the surface. Multiple control lines are envisioned between the surface and the bottomhole assembly. Multiple connectors can be used in a given production string, and provisions can be made for operation of a multiplicity of downhole components from the control line system which extends along the production tubing.

BRIEF DESCRIPTION OF THE DRAWING

Figures 1a–c are a sectional elevational view of the outer or lower portion of the connector with the running tool inserted therein.

Figures 2a–c show both portions of the connector in sectional elevation connected to each other.

Figures 3a–d show a passage around a packer in sectional elevational view, indicating the path of the control line around the packer sealing and gripping assemblies.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to Figures 1a–c, the running tool **R** is shown fully inserted into the lower body **L** of the connector **C**. The lower body **L** has a thread **10** at its lower end **12**, which is best seen in Figure 2c. Thread **10** is connected to the bottomhole assembly, which is not shown. This bottomhole assembly can include packers, sliding sleeves, and other types of known equipment.

The running tool **R** is made up of a top sub **14**, which is connected to a sleeve **16** at thread **18**. Sleeve **16** is connected to sleeve **20** at thread **22**. Sleeve **20** is connected to bottom sub **24** at thread **26**. Bottom sub **24** has a bottom passage **28**, as well as a ball seat assembly **30**. The ball seat assembly **30** is held to the bottom sub **24** by shear pin or pins **32**. Although a shear pin or pins **32** are shown, other types of breakable members can be employed without departing from the spirit of the invention. The ball seat assembly **30** has a tapered seat **34** to accept a ball **36** to build pressure in internal passage **38**. Bottom sub **24** also has a lateral port **40** which, in the position shown in Figure 1c, is isolated from the passage **38** by virtue of O–ring seal **42**. Those skilled in the art will appreciate that during run–in, the ball **36** is not present. Accordingly, passage **38** has an exit at the passage **28** so that the bottomhole assembly, which is supported off the lower end of the lower body **L**, can be run in the hole while circulation takes place. Eventually, the bottomhole assembly is stabbed into a sump packer (not shown), which seals off the circulation through passage **38**. It is at that time that the ball **36** can be dropped onto seat **34** to close off passage **38**. At that time, O–ring **42** prevents leakage through the port **40**, allowing pressure to be built up in passage **38** above the ball **36**. This pressure can be communicated through a lateral port **44**, as seen in Figure 1a, into orientation sub **46**. Orientation sub **46** has a passage which makes a right–angle turn **48** extending therethrough. Seals **50** and **52** prevent leakage between orientation sub **46** and the running tool **R**.

The running tool **R** also has a groove **54** to accept a dog **56** which is held in place by assembly of retaining cap **58**, as will be described below. When retaining cap **58** is secured to orientation sub **46** at thread **60**, with dog **56** in place in groove **54**, the running tool **R** is locked in position with respect to orientation sub **46**.

Looking further down the running tool **R** as shown in Figure 1b, a seal assembly **62** encounters a seal bore **64** to seal between the lower body **L** and the

running tool R. A locking ratchet assembly 66, of a type well-known in the art, is located toward the lower end of the running tool R. The ratchet teeth in a known manner allow the running tool R to advance within the lower body L but prevent removal unless a shear ring 68 is broken when contacted by a snap ring 70 after application of a pick-up force.

The lower body L includes a tubular housing 72 which, as previously stated, has a lower end 12 with a thread 10 for connection of the bottomhole assembly. In the preferred embodiment, a pair of control lines, only one of which 74 is shown, run longitudinally along the length of the tubular housing 72. The control line 74 terminates at an upper end 76 with a receptacle 78. In order to make the control line connection, the control line 74 becomes a passage 80 prior to the termination of passage 80 in the receptacle 78. Passage 80 is shown in alignment with passage 48. This occurs because when the running tool R is made up to the lower body L, preferably at the surface, an alignment flat 82 engages a similarly oriented alignment flat 84. Alignment flat 82 is on the housing 72, while alignment flat 84 is on communication crossover 86. The crossover 86 contains a passage 88 which is an extension of passage 48. Passage 88 terminates in a projection 90, which is sealed into the receptacle 78 by O-rings 92 and 94, which are mounted to the projection 90. Although O-rings 92 and 94 are shown, other sealing structures are within the scope of the invention. In essence, the receptacle 78 has a seal bore to accept the seals 92 and 94. The orientation of the opposed flats 82 and 84 ensure that the crossover 86 rotates to orient the projection 90 in alignment with receptacle 78 as the crossover 86 is advanced over the running tool R. To complete the assembly after proper alignment, the running tool R is firmly pushed into the lower body L so that the seal 62 engages seal bore 64, and the locking ratchet assembly 66 fully locks the running tool R to the lower body L. At this time, the crossover 86, which is made up over the running tool R and is now properly aligned, has its projection

90 progress into the receptacle 78. Thereafter, the projection 90 is fully advanced into a sealing relationship into the receptacle 78 so that its passage 48 is in alignment with port 44. This orientation is ensured by alignment of a window 96 in the orientation sub 46 with the groove 54 on the top sub 14 of the running tool R. When such an alignment is obtained, the dog 56 is pushed through window 96 so that it partially extends into the window and partially into groove 54. At that time, the retaining cap 58 is threaded onto thread 60 to secure the position of the dog 56, which, in turn, assures the alignment of port 44 with passage 48. The running tool R is now fully secured to the lower body L of the connection C. Rigid or coiled tubing can now be connected to the running tool R at thread 14.

The bottomhole assembly (not shown), which is supported off the lower end 12 of the body 72, can now be run into position in the wellbore while circulation continues through passage 38 and outlet 28. Ultimately, when the bottomhole assembly is stabbed into a sump packer, circulation ceases and a signal is thus given to surface personnel that the bottomhole assembly has landed in the desired position. At that time, the ball 36 is dropped against the seat 34, and pressure is built up in passage 38 above ball 36. This pressure communicates laterally through port 44 into passage 48 and, through the sealed connection of the projection 90 in the receptacle 78, the developed pressure communicates into the control line 74 to the bottomhole assembly. Since, in the preferred embodiment, there are actually a pair of control lines 74, there are multiple outlets 44 in the running tool R such that all the control lines 74 going down to the bottomhole assembly and making a U-turn and coming right back up adjacent the tubular housing 72 and terminating in a similar connection to that shown in Figure 1a, are all pressure-tested simultaneously. If it is determined that there is a loss of pressure integrity in the control line system 74 at this point, the bottomhole assembly can be retrieved using the running tool R or alternatively, the running tool R can be released from the lower body L and

the bottomhole assembly can be retrieved in a separate trip. If, on the other hand, the integrity of the control line system **74** is acceptable, pressure can be further built up in passage **38** to blow the ball **36**, with the ball seat assembly **30**, into the bottom of bottom sub **24** where they are both caught. As a result, the port **40** is exposed so that pressure can be communicated to the bottomhole assembly for operation of its components, such as a packer or a sliding sleeve valve, for example. Once the bottomhole assembly is completely functioned through the pressure applied at port **40**, an upward force is applied to the running tool **R** to break the shear ring **68** so that the entire assembly of the running tool **R**, along with the orientation sub **46** and the crossover **86**, can be removed. As this pick-up force is applied, the projection **90**, which is a component of the crossover **86**, comes out of the receptacle **78** so that each of the control lines **74** (only one being shown) becomes disconnected as the running tool **R** is moved out completely from the lower body **L**.

At this point the upper string **98**, shown in Figure 2a, which is connected to the upper body **U**, can be run in the wellbore for connection to the lower body **L**. Alternatively, the upper string **98** can be inserted at a much later time.

The upper body **U** has some constructional differences from the orientation sub **46** and the crossover **86** used in conjunction with the running tool **R**. Whereas the components **46** and **86** were assembled by hand at the surface, the counterpart components of the upper body **U** must connect automatically to the lower body **L**. Those skilled in the art will be appreciate that the view in Figures 2a–c is the view of the upper body **U** fully connected into the lower body **L**. However, there are certain components that are in a different position as the upper body **U** approaches the lower body **L**. The string **98** extends as a mandrel to support the upper body **U** and has numerous similarities to the running tool **R** which will not be repeated in great detail at this point. A seal assembly **62** contacts a seal bore **64**, while a locking mechanism of the ratchet type **66** is employed in upper body assembly **U**,

just as in the running tool **R**. Also present is a shear release in the form of an L-shaped ring **68**, which for release is broken by a snap ring **70**. The mandrel **100**, which forms an extension of the upper string **98**, includes an outer groove **102**. During the initial run-in, a series of collet heads **104** is initially in alignment with groove **102**. These collet heads **104** are held securely in groove **102** by sleeve **17** (shown in section in Figure 2c). Sleeve **17** is pushed into this position by spring **126**. The collet heads **104** extend from a series of long fingers **106**, which in turn extend from a ring **108**. Ring **108** is connected at thread **110** to orientation sub **112**. Orientation sub **112** has a passage **114**, including an upper end **116** which one of the accepts the control lines **74'** which run from the surface to upper end **116** along the upper string **98**. Again, it should be noted that a plurality of control lines **74** and **74'** are contemplated so that when the upper body **U** is connected to the lower body **L**, more than one control line connection is made simultaneously. As previously stated, the control line from the surface **74'** extends down to the upper end **116** and then becomes passage **114**. A crossover **86** has a passage **88** which is in alignment with passage **114**. As before, the alignment flat **82** on the tubular housing **72** engages an alignment flat **84'** on the crossover **86**. However, rotational movement about the longitudinal axis is still possible while the collet heads **104** are longitudinally captured in groove **102**. This ability to rotate while longitudinally trapped allows the mating flats **82** and **84'** to obtain the appropriate alignment so that ultimately, passage **80** can be connected to passage **88** as the projection **90** enters the receptacle **78**, as described above. As this is occurring, the groove **102**, with the collet heads **104** longitudinally trapped to it, comes into alignment with groove **120**, thus allowing the collet heads **104** to enter groove **120** and subsequently become locked in groove **120** as a result of opposing surface **122**. This is precisely the position shown in Figures 2a and 2b. Thus, as the connection is firmly made up connecting passage **114** to passage **80** by virtue of a sealed connection between

the projection **90** and the receptacle **78**, that position is locked into place as collet heads **104** become trapped against longitudinal movement into groove **120** which is on the tubular housing **72** of the lower body **L**. It is at that time that further longitudinal advancement of the upper string **98** allows the seal **62** to enter the seal bore **64** and ultimately the locking assembly **66** to secure the mandrel **100** to the lower housing **72**. Thus, with seal assembly **62** functional, production can take place through the passage **124** in the mandrel **100**. The seal assembly **62** in effect prevents leakage between the mandrel **100** and the tubular housing **72**, which is a part of the lower body **L**.

When disconnecting, collet **104** drops into groove **102**, and the connection alignment sub **112** and housing **72** start to move apart. To ensure the collet **104** remaining in the groove **102**, sleeve **17** (shown in section in Figure 2c) is pushed over the collet **104** by spring **126**, locking it in place in the groove **102**. The reverse procedure happens when reconnecting.

As shown in Figure 2c, the control line **74** extends beyond the lower end **12** and can extend through a packer as illustrated in Figures 3a–d. The control line **74** is literally inserted into opening **128** and secured in place with a jam nut (not shown) threaded into threads **130**. The control line **74** extends through a passage **132** and emerges out at lower end **134**, where a jam nut (not shown) is secured to threads **136**. To facilitate manufacturing, the lower end of the passage **132** extends through a sleeve **138**. The passage through the sleeve **138** is aligned with the main passage **132** and the aligned position is secured by a dog **140**, which is locked in position by a ring **142**. Also shown in Figure 3d in dashed lines is the return control line from the bottomhole assembly going back up to the surface, which passes through the packer shown in Figures 3a–d in a similar manner and preferably at 180° to the passage **132** which is illustrated in the part sectional view. The control

line **74** shown in dashed lines comes back up into the lower body **L** and is connected to the upper body **U** in the manner previously described.

Those skilled in the art will appreciate that what has been shown is a simple way to test the control line **74** adjacent the bottomhole assembly without running the upper string **98** with its attendant control line segments. Once the lower portion of the control line **74** has been tested and determined to be leak-free, the running tool **R** illustrated in Figures 1a-c can be used to set downhole components. This is accomplished by exposing passage **40** to allow pressure communication to the bottomhole assembly through the running tool **R**. The running tool **R** is simply removed by a pull which breaks the shear ring **68** to allow a pull-out force to remove the running tool **R** from the lower body **L**. Thereafter, the upper body **U**, attached to the lower end of the upper string **98**, is run in the wellbore with the remaining control lines **74'**. The connector self-aligns due to the action between the inclined flats **82** and **84'**. The orientation sub **112** and the crossover **86** of upper body **U** of the connection **C** are free to rotate within groove **102** to facilitate this self-alignment. The control line segments **74** are made up as a result of this alignment and the male/female connection is sealed, as explained above. More than one control line connection is made up simultaneously. As the male/female components come together in a sealed relationship, their position is locked as the collet heads **104** become trapped in the groove **120** of the tubular housing **72**. Further advancement of the mandrel **100** relative to the trapped collet hears **104** results in seal **62** engaging the seal bore **64** and locking ratchet mechanism **66**, securing the mandrel **100** to the tubular housing **72**. At this time, the production tubing is sealingly connected as the seal assembly **62** seals between the mandrel **100** and the tubular housing **72**. The control line **74**, one of which is shown in Figures 2a-c, is connected as the male and female components provide a continuous passage when sealingly connected through the boss **144** which contains the passage **80**.

Thus, the control line **74** requires a connection at the lower end **146** of the boss **144**. The control line from the surface **74'**, as seen in Figure 2a, also has a connection to upper end **116** of orientation sub **112**. Thus, when the male and female components are interconnected as described above, a continuous sealed passage is formed, comprising of passages **114**, **88**, and **80**, which extends from the upper end **116** of orientation sub **112** to the lower end **146** of boss **144**.

Multiple connectors **C** can be used in a given string, and the control lines **74** can have outlets at different locations in the well. One of the advantages of using the connector **C** is that the bottomhole assembly can be run into the well and fully tested along with its associated control lines while the production tubing can be installed at a later time with the remainder of the control line back to the surface. The control line in one application can run from the surface and be connected downhole, as previously described. The control line **74** can continue through a packer through a passage such as **132**. Generally speaking, the control line **74** will have a connection immediately above the packer. In multiple packer completions, since it is known what the distance between one packer and the next packer downhole is going to be, a predetermined length of control line can extend out the lower end **134** when the packer shown in Figure 3 is sent to the wellsite. The rig personnel simply connect the control line **74** extending out the lower end **134** to the next packer below, and the process is repeated for any one of a number of packers through which the control line **74** must pass as it goes down the wellbore before making a turn to come right back up to the surface. One application of such a technique is to install fiber optic cable through the control line so that the fiber optic cable **F** can extend from the surface to the bottomhole assembly and back up again. Through the use of the fiber optic cable, surface personnel can determine the timing and location of temperature changes which are indicative of production of undesirable fluids. Therefore, on a real-time basis, rig personnel can obtain

feedback as to the operation of downhole valves or isolation devices to produce from the most desirable portion of the well and minimize production of undesirable fluids. Fluid pressure can be used to insert or remove the fiber optic cable. There are numerous other possible uses for this technology to be used with other than fiber optic cable without departing from the spirit of the invention.

Those skilled in the art will appreciate that the orientation of the male/female components to connect the control line **74** downhole can be in either orientation so that the male component is upwardly oriented or downwardly oriented without departing from the spirit of the invention. The invention encompasses a connector which can be put together downhole and which is built in a manner so as to allow control line testing, as well as functioning of bottomhole components, without having run the upper string and its attendant control line. Thus, it is also within the scope of the invention to connect the control line to the upper string in a multitude of different ways as long as the connection can be accomplished downhole and the connection is built to facilitate the testing of the control line adjacent the bottomhole components, as well as the subsequent operation of the necessary bottomhole components, all prior to inserting the upper string. Those skilled in the art will appreciate that the preferred embodiment described above illustrates a push–together technique with an orientation feature for the control line segment of the joint. However, different techniques can be employed to put the two segments of the connector together downhole without departing from the spirit of the invention.

Any number of different pressure–actuated components can be energized from the control line **74**, such as plugs, packers, sliding sleeve valves, safety valves, or the like. The control line, since it runs from the surface down to the bottomhole assembly and back to the surface, can include any number of different instruments or sensors at discrete places, internally or externally along its path or continuously throughout its length, without departing from the spirit of the invention. As an

example, the use of fiber optic cable from the surface to the bottomhole assembly and back to the surface is one application of the control line **74** illustrated in the invention. Any number of control lines can be run using the connector **C** of the present invention. Any number of connectors **C** can be employed in a string where different control lines terminate at different depths or extend to different depths in the wellbore before turning around and coming back up to the surface.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made without departing from the spirit of the invention.

WHAT IS CLAIMED IS:

1. An apparatus for downhole testing, from the surface, of at least one control line adjacent a downhole tool assembly comprising:

at least one tubular housing connectable to the downhole tool assembly, said housing comprising at least one exterior connection connected to at least one control line which extends toward the downhole tool assembly

a running tool defining a wall and connectable to said tubular housing to allow said tubular housing with said control line and the downhole tool assembly to be run to a desired location downhole, said running tool in fluid communication with said exterior connection through an opening in said wall so as to allow a pressure test at said desired location through said running tool of said at least one control line which extends from said exterior connection.

2. The apparatus of claim 1, wherein:

said running tool further comprises a valve which, in a closed position, facilitates pressurization of said at least one control line and, in an open position, allows pressure to be transmitted through said housing to operate the downhole tool assembly.

3. The apparatus of claim 2, wherein:

said running tool is sealingly engaged to said housing.

4. The apparatus of claim 3, wherein:

said running tool is releasably engaged to said housing.

5. The apparatus of claim 1, wherein:

said at least one exterior connection comprises one half of a male female push in connection, said running tool comprising the other half of said male female connection whereupon makeup of said male female connection, the interior or said running tool is in fluid communication with said control line through said at least one connection.

6. The apparatus of claim 5, further comprising:

an upper housing having the same portion of said male female connection as said running tool, said upper housing insertable downhole after removal of said running tool, said upper housing connected to a control line segment which extends from the surface to the portion of the male female connection on said upper housing, whereupon makeup of said male female connection said control line extends from the surface past said tubular housing and toward the downhole tool assembly.

7. The apparatus of claim 6, wherein:

said upper housing and said tubular housing comprise an alignment device to insure proper orientation of said male and female components of each said connection before they can be pushed together downhole.

8. The apparatus of claim 7, further comprising:

a locking mechanism which engages after insertion of said male into said female component of each said connection to selectively hold them together.

9. The apparatus of claim 8, wherein:

said upper housing is selectively, releasably, sealingly locked to said tubular housing.

10. The apparatus of claim 1, further comprising:

at least two exterior connections on said tubular housing, said at least one control line extending from one of said exterior connections to or through at least part of the downhole tool assembly and terminating at another exterior connection on said tubular housing, whereupon said running tool in fluid communication with said exterior connections can pressure test the U-shaped portion of said at least one control line between said exterior connections.

11. The apparatus of claim 10, further comprising:

at least one upper housing comprising at least one pair of control lines connected to it which extend from the surface, said upper housing insertable downhole after removal of said running tool to connect said at least one pair of control lines respectively to said at least two exterior connections on said tubular housing downhole so as to provide at least one continuous control line from the surface beyond said tubular housing and back to the surface.

12. The apparatus of claim 11, further comprising:

at least two tubular housings spaced from each other and assembled to the downhole tool assembly;

a plurality of pairs of control lines connected from said surface to said upper housing and extending to different locations downhole by a connection on at least one of said tubular housings.

13. The apparatus of claim 1, further comprising:

an upper housing having at least one control line connected to it which extends from the surface, and terminates in an exterior connection, said upper

housing insertable downhole after removal of said running tool, whereupon said exterior connections of said tubular housing and said upper housing sealingly engage downhole to extend said at least one control line from the surface past said tubular housing and toward the downhole tool assembly.

14. The apparatus of claim 13, further comprising:

at least one signal transmitting cable disposed in said control line extending from the surface to beyond said tubular housing.

15. The apparatus of claim 14, wherein:

said upper housing comprises at least a pair of control lines extending from the surface and terminating at at least a pair of external connections on said upper housing;

said tubular housing comprising at least one pair of exterior connections between which extends a control line forming a generally U-shape and extending downward toward the downhole tool assembly;

said cable comprises a fiber optic cable extending from the surface through said control line downhole and back to the surface.

16. The method of testing at least one control line downhole comprising:

connecting a tubular housing to a downhole tool assembly, said tubular housing having at least one external control line and at least one connection for said control line;

connecting a running tool to said tubular housing;

providing fluid communication through said running tool into said control line;

connecting tubing to said running tool;

running in said running tool on said tubing;

pressure testing the control line extending downhole from said tubular housing through said running tool.

17. The method of claim 16, further comprising:

opening a valve in said running tool after said pressure testing;

operating a portion of the downhole tool assembly through said running tool.

18. The method of claim 16, further comprising:

removing the running tool;

connecting at least one upper control line with an end connection to an upper housing;

running in said upper housing and upper control line on tubing;

joining downhole said end connection on said upper control line to said connection on said tubular housing.

19. The method of claim 18, further comprising:

extending a signal cable from the surface through said upper control line and into said control line, extending from the tubular housing and toward the downhole tool assembly.

20. The method of claim 19, further comprising:

providing at least one pair of upper control lines each ending in an end connection externally to said upper housing;

providing said control line on said tubular body in a generally U-shape with at least a pair of connections on said tubular housing;

providing an alignment feature between said housings so as to align connections between them;

moving said housings together to selectively sealingly secure said aligned connections;

running at least one fiber optic cable as said signal cable from the surface, down through one said upper control line, past said tubular housing through the control line connected to it, and back to the surface through another said upper control line on said upper body.

BAKER\546 UTILITY APPLICATION\lee

ABSTRACT OF THE INVENTION

A connector is disclosed to facilitate the testing of a control line or lines adjacent a bottomhole assembly. A running tool is connected to a lower portion of the connector which is, in turn, connected to the bottomhole assembly. The running tool allows testing of the control line adjacent the bottomhole assembly and thereafter, the operation of components of the bottomhole assembly. The running tool is removed and the upper portion of the string, including the mating portion of the connector at its lower end, is inserted into the wellbore. The connector components are self-aligning and lock to each other downhole to complete the production tubing and the control line tubing to the surface. Multiple control lines are envisioned between the surface and the bottomhole assembly. Multiple connectors can be used in a given production string, and provisions can be made for operation of a multiplicity of downhole components from the control line system which extends along the production tubing.

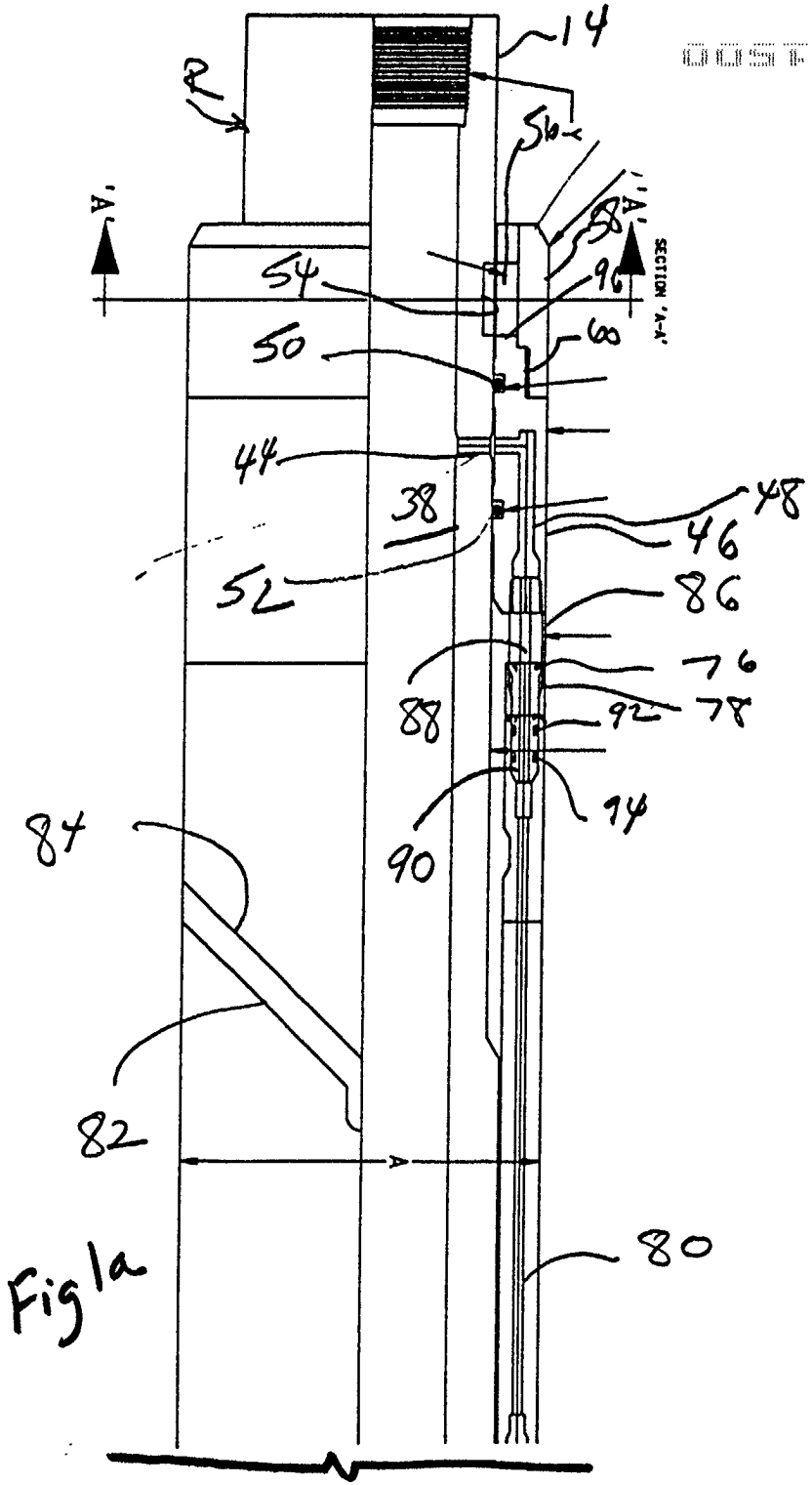


Fig 1a

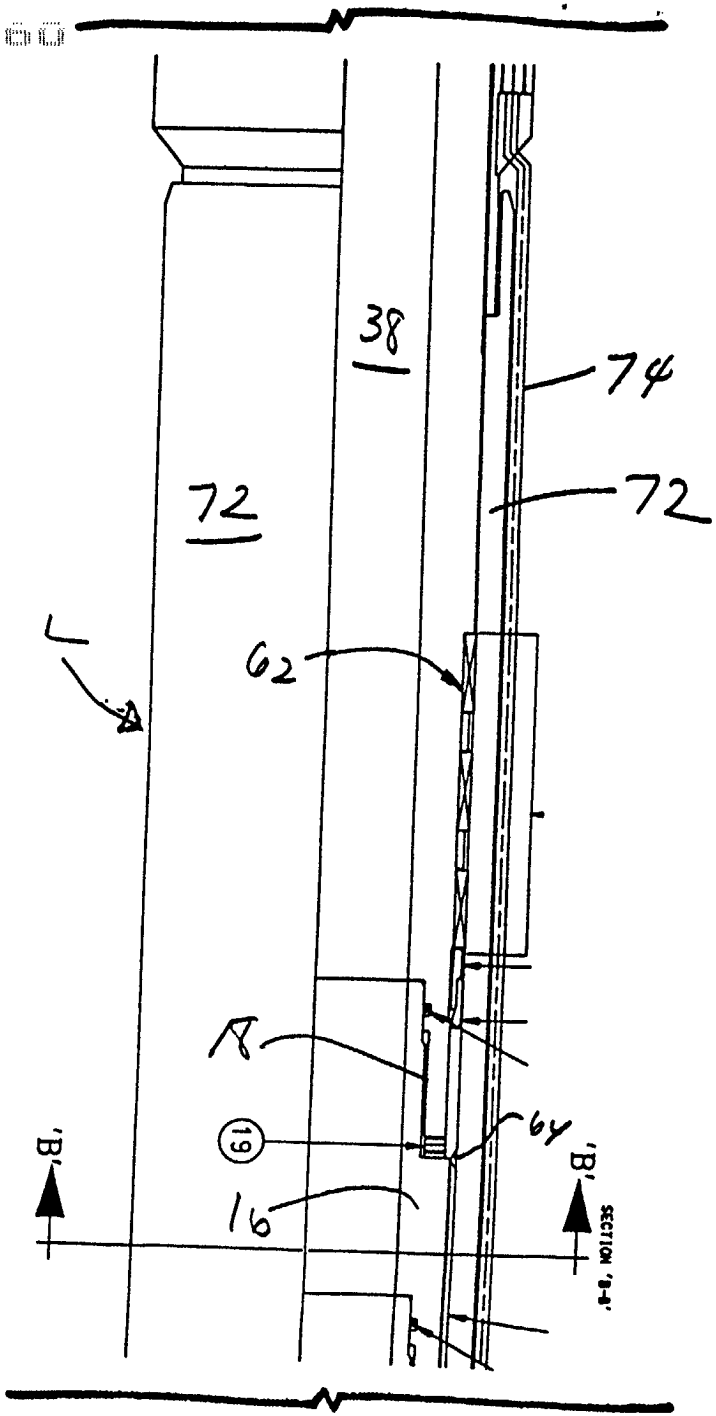
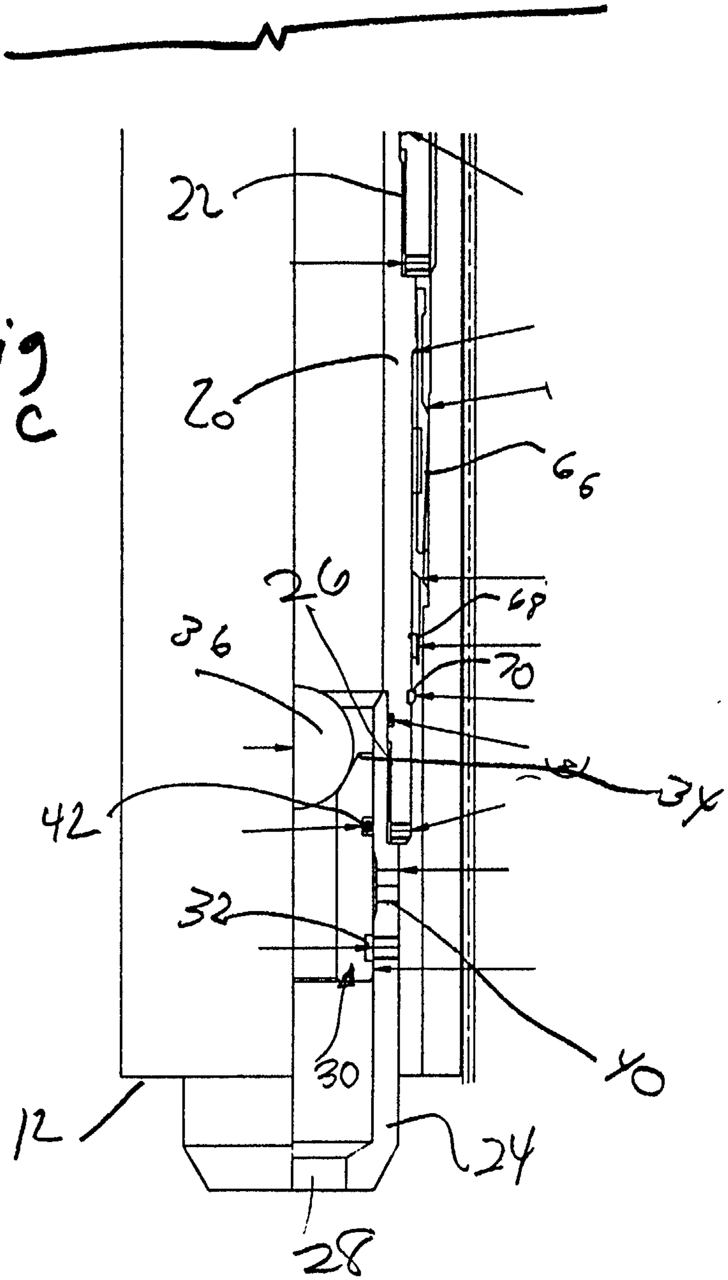


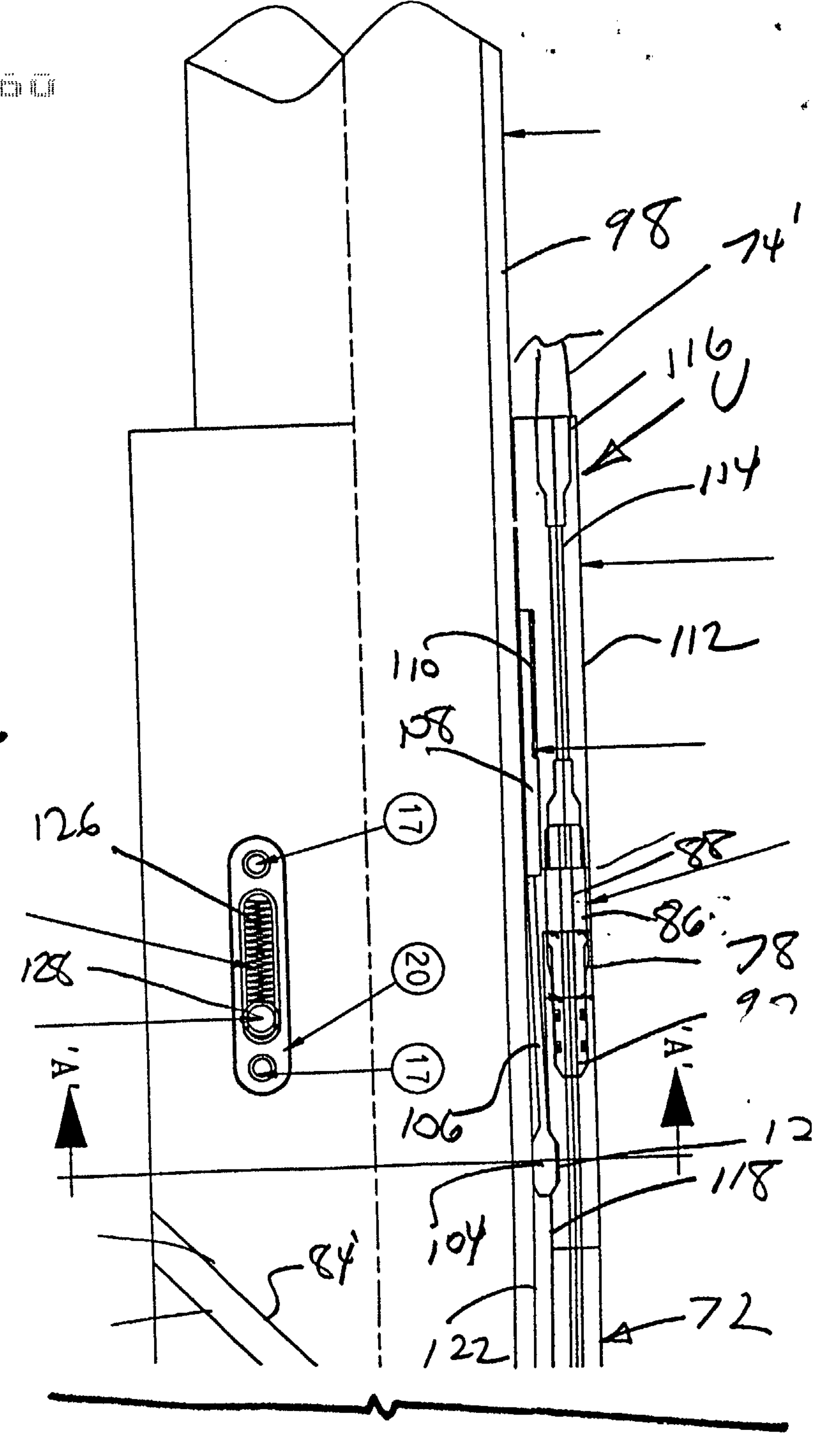
Fig. 1b

Fig 1C



12
20
22
24
26
28
30
32
34
36
40
42
66
68
70

Fig. 2a



17
20
17
72
74'
78
84'
86
88
98
104
106
108
110
112
114
116
118
122
126
128
'A'
'A'

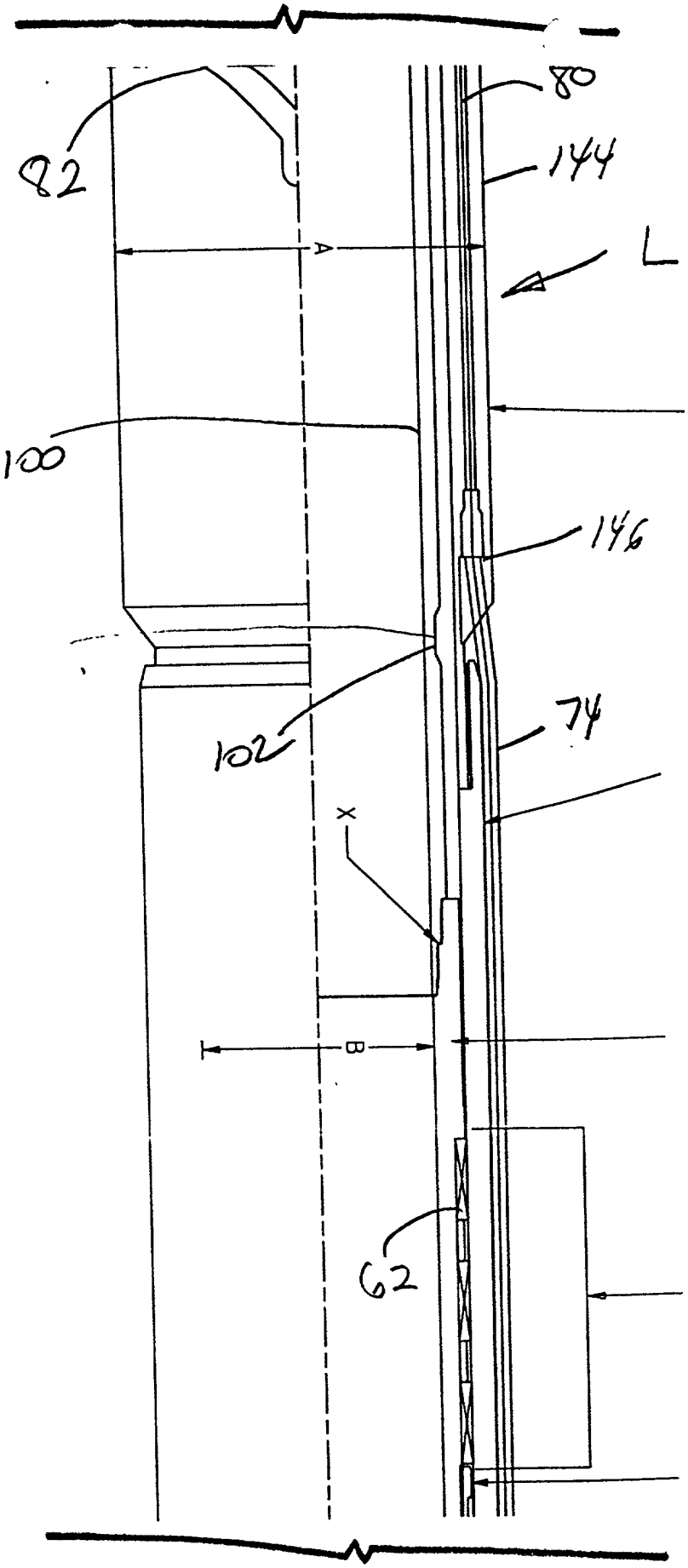


Fig. 2b

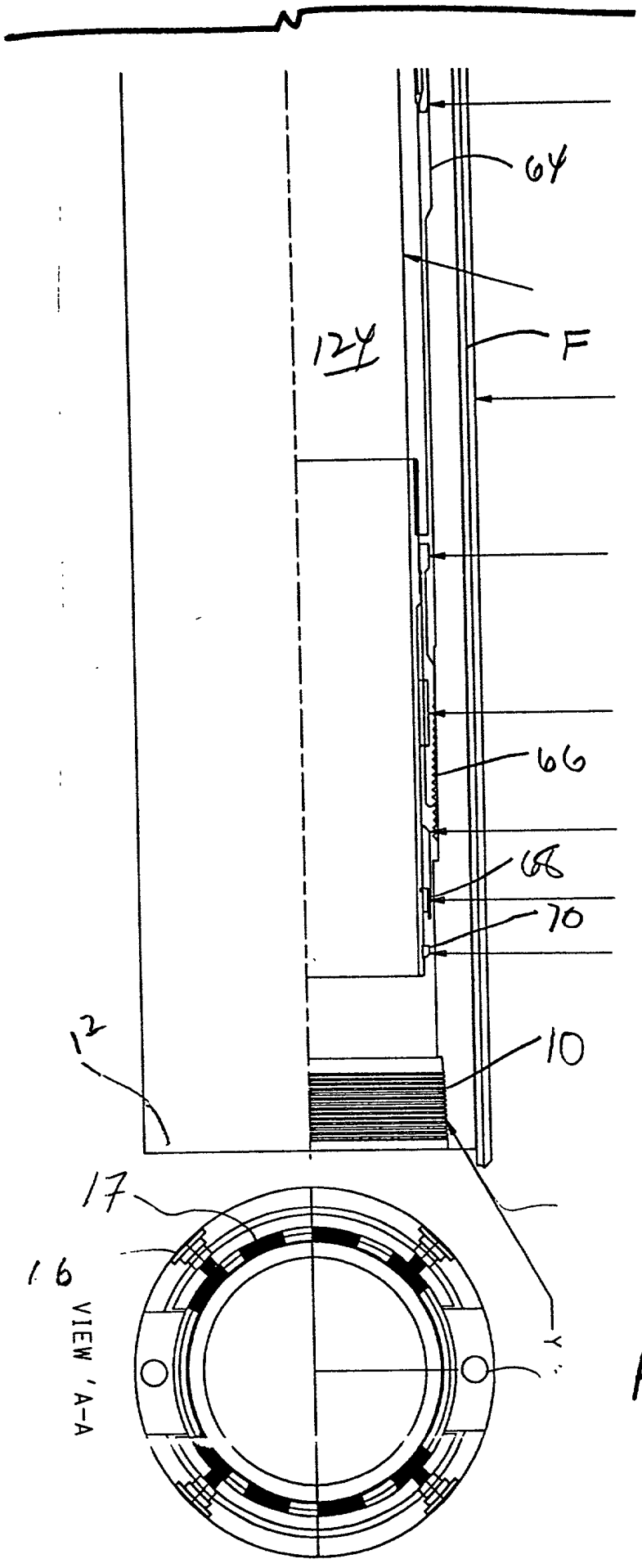


Fig. 2C

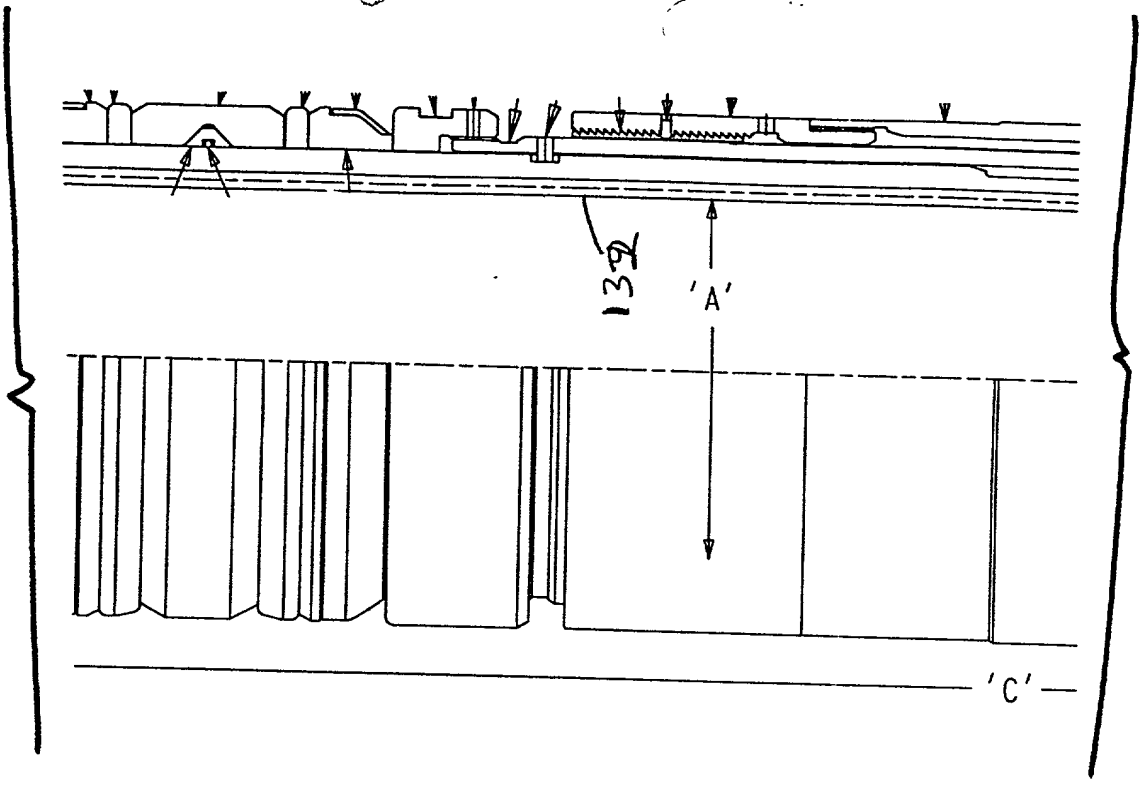


Fig. 3D

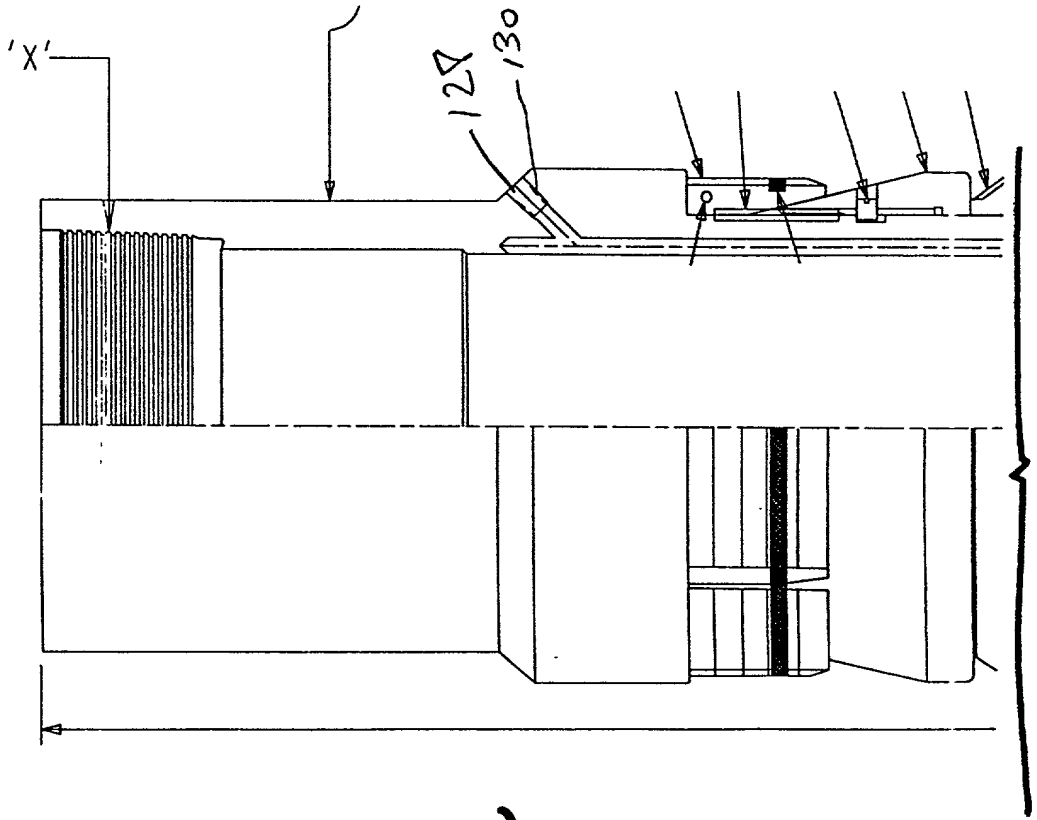


Fig. 3E

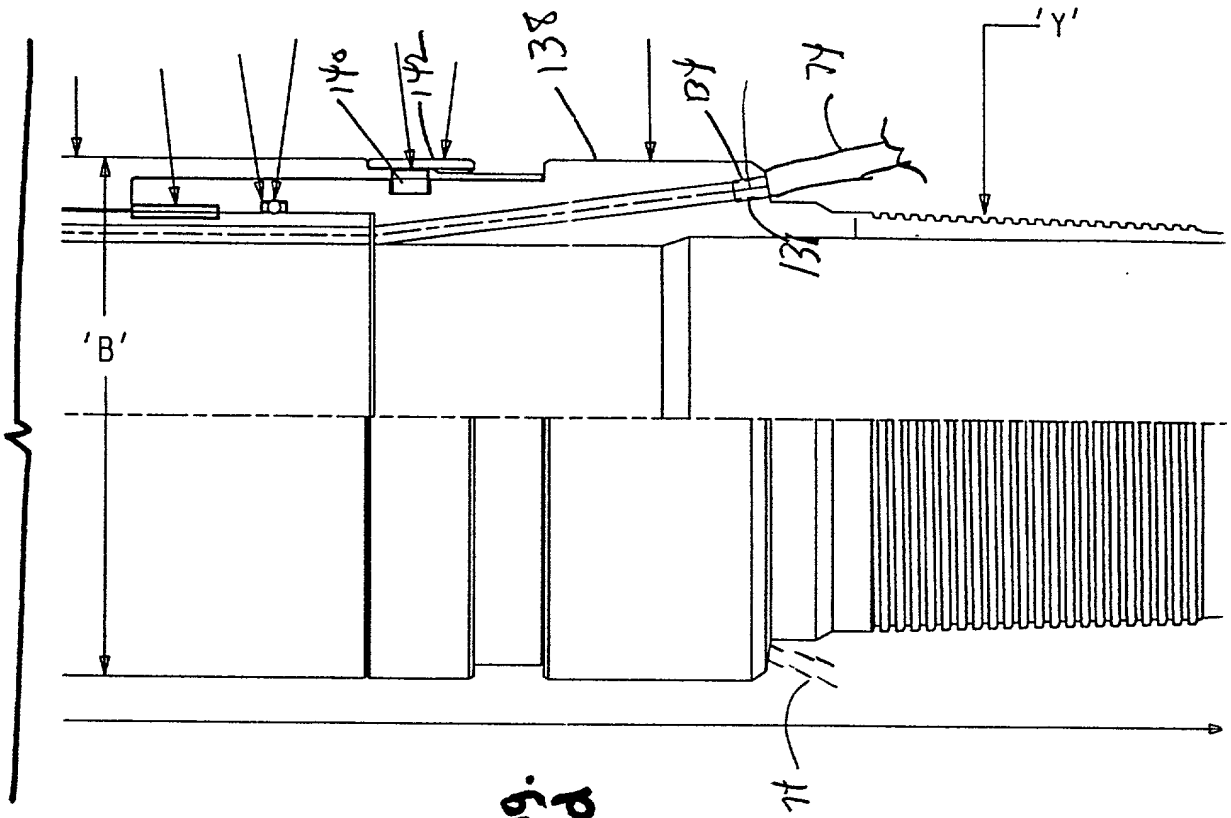


Fig. 3D

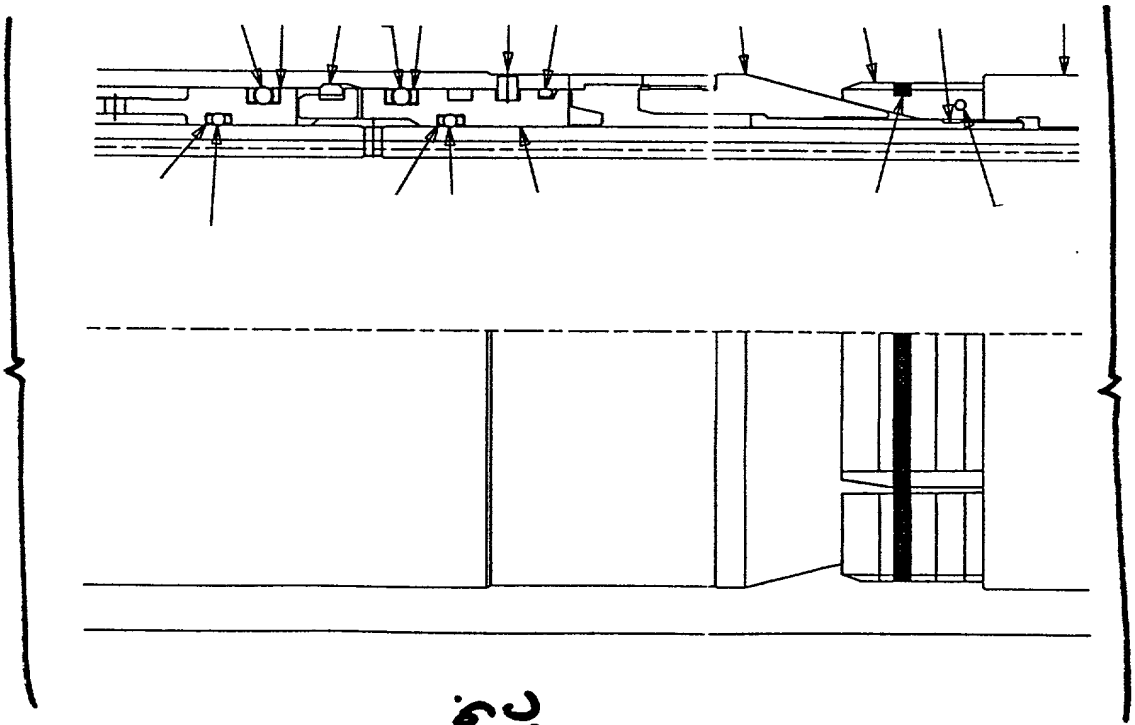


Fig. 3C

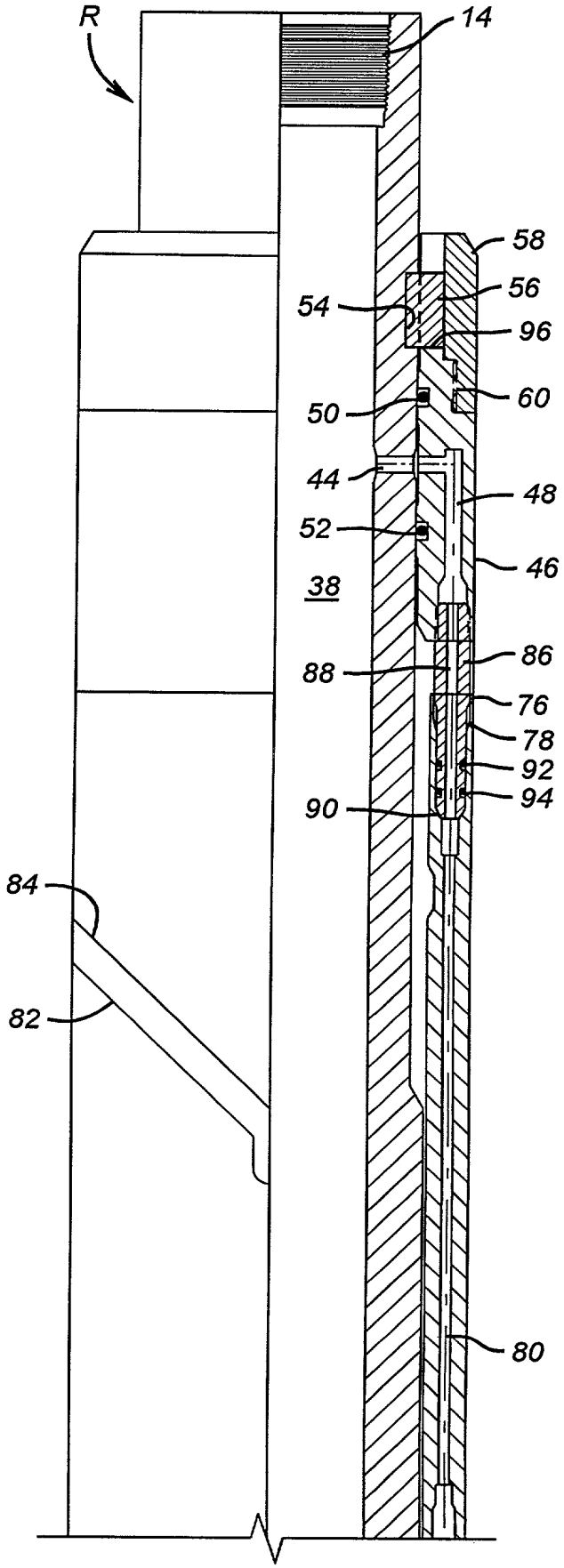


FIG. 1a

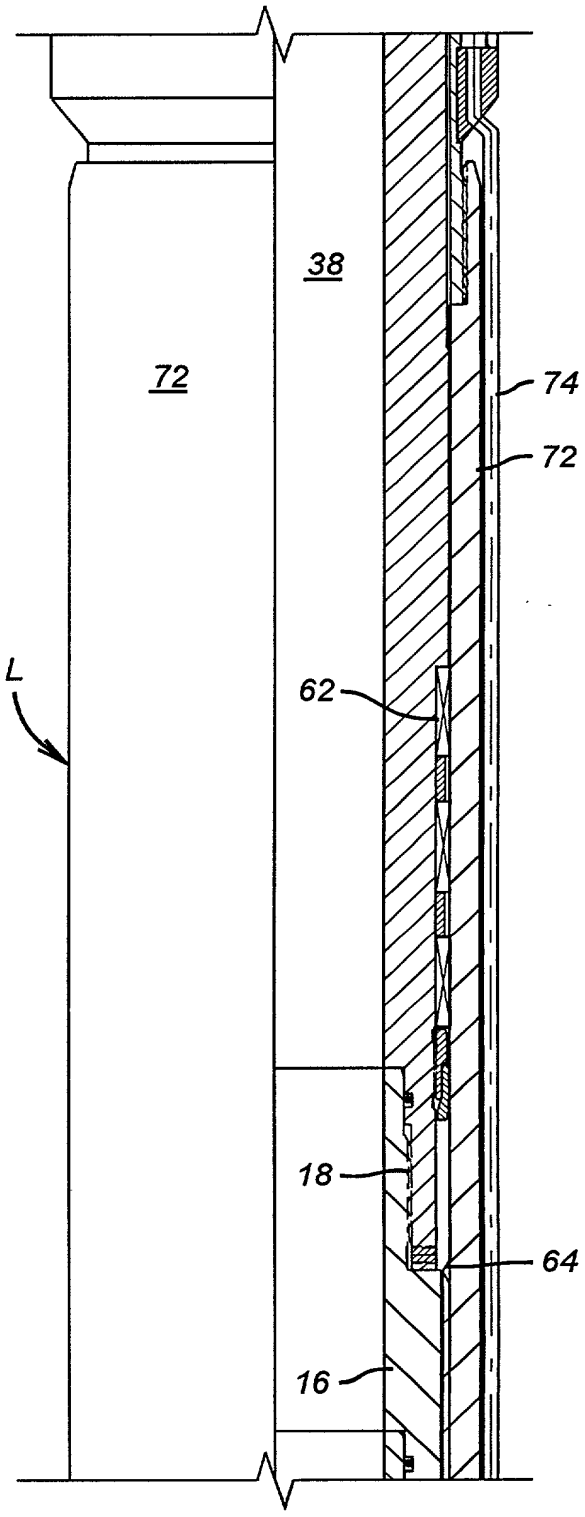


FIG. 1b

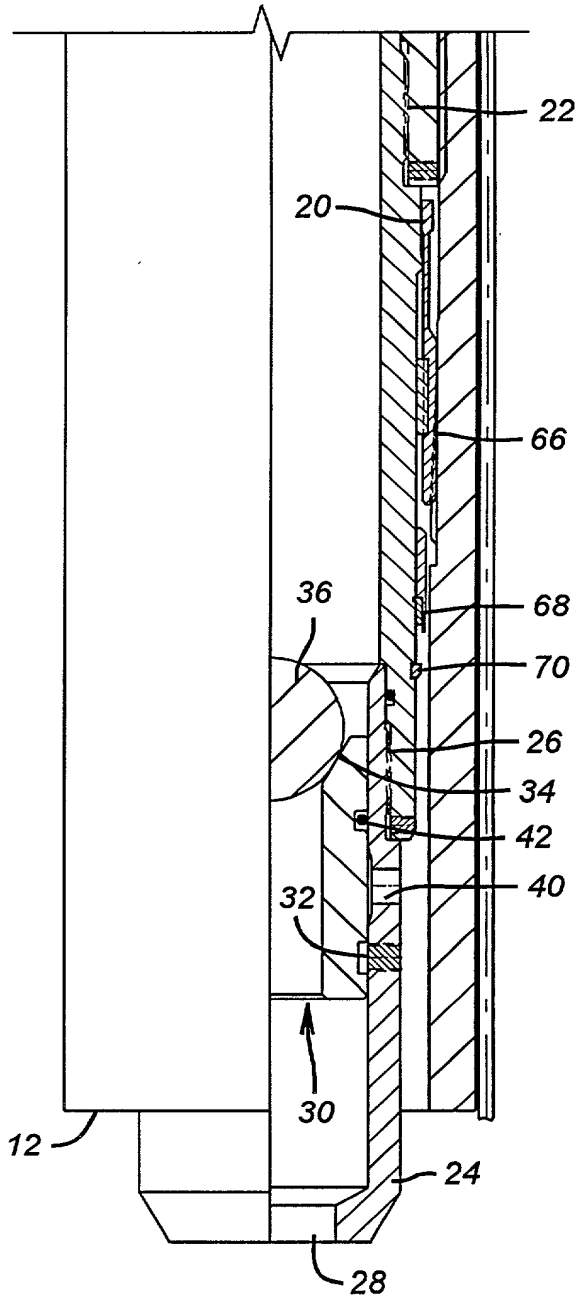


FIG. 1c

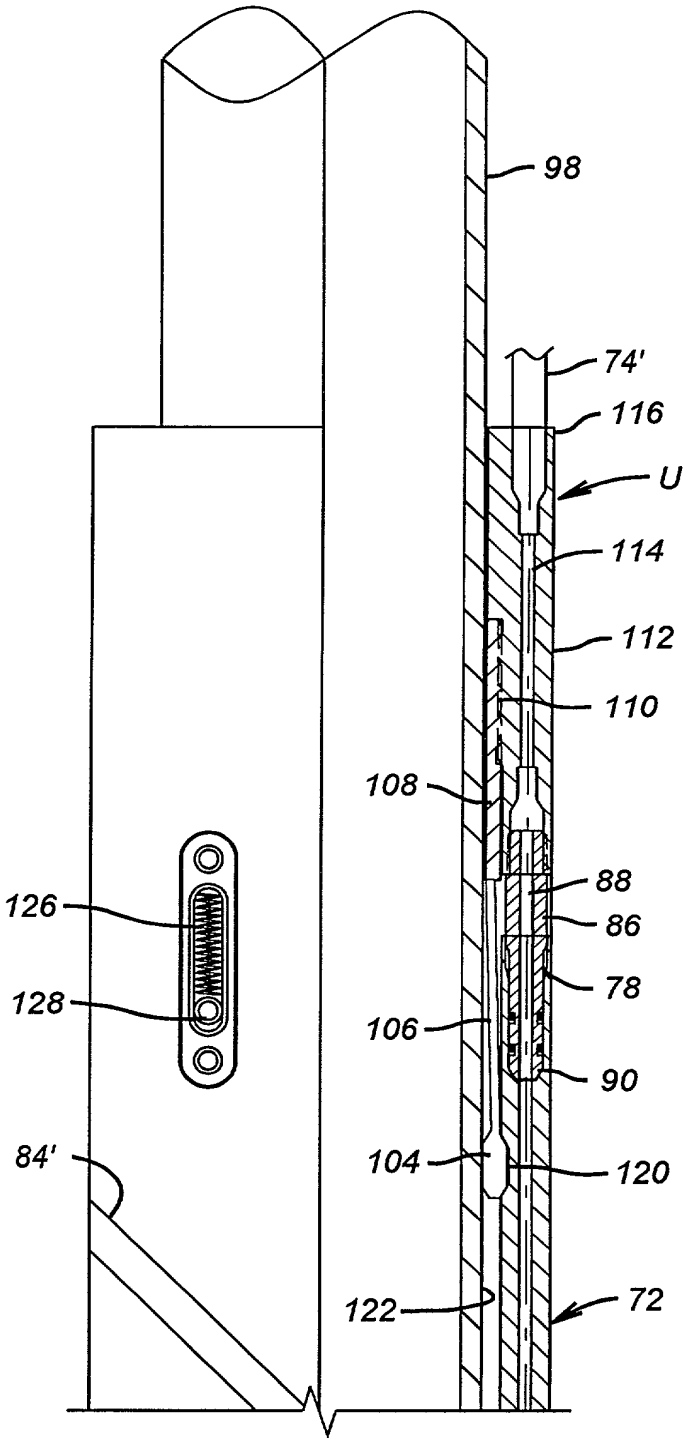

98
74'
116
U
114
112
110
108
88
86
78
106
90
104
120
122
72
126
128
84'

FIG. 2a

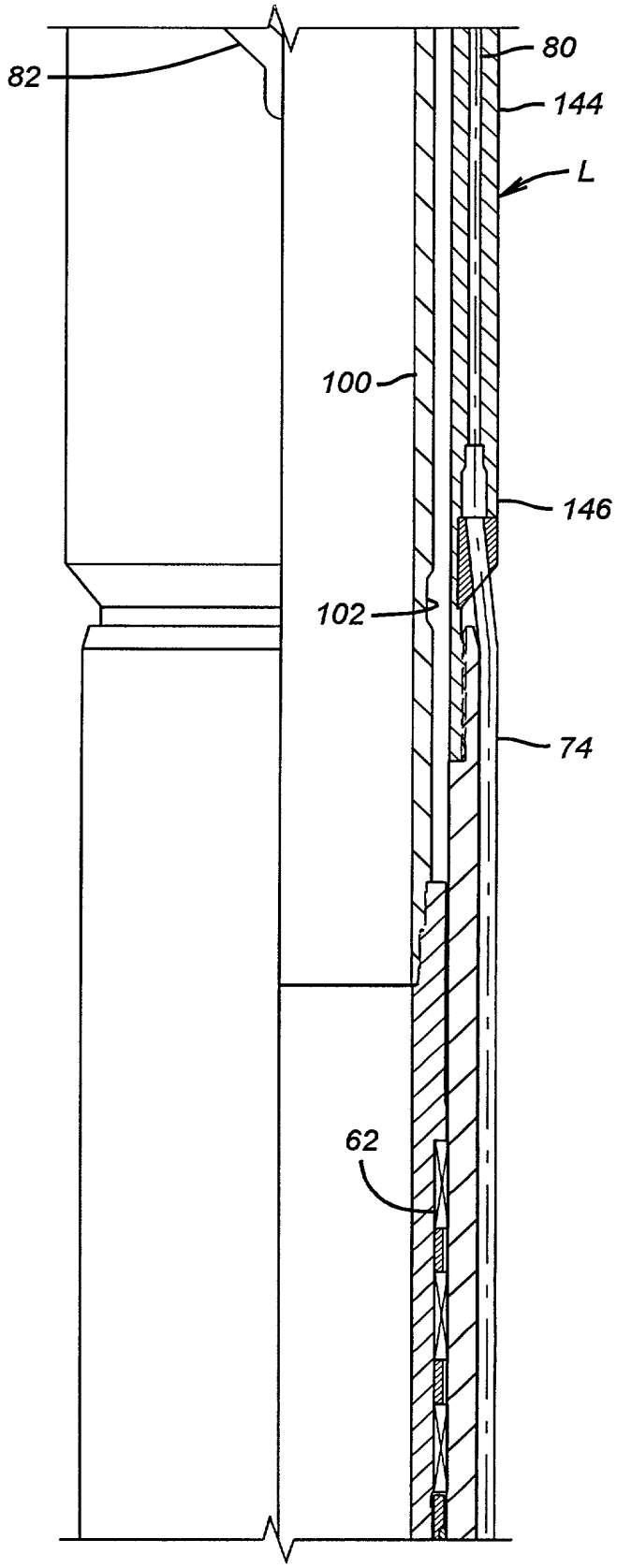


FIG. 2b

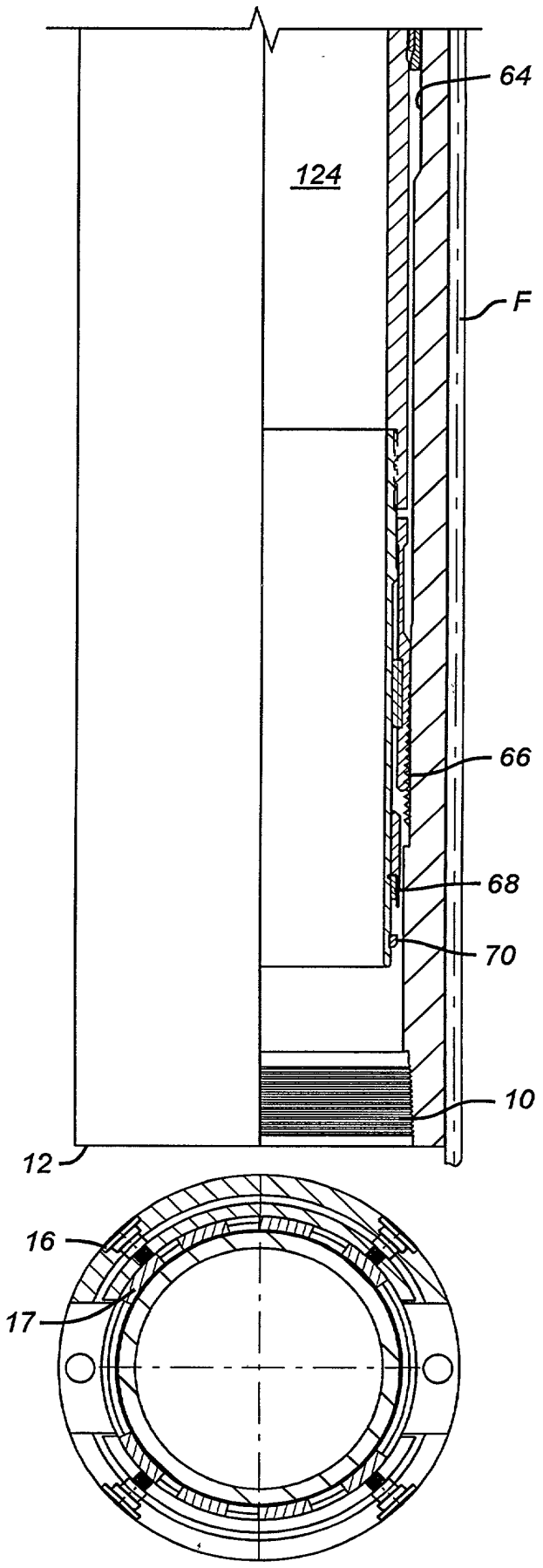


FIG. 2c

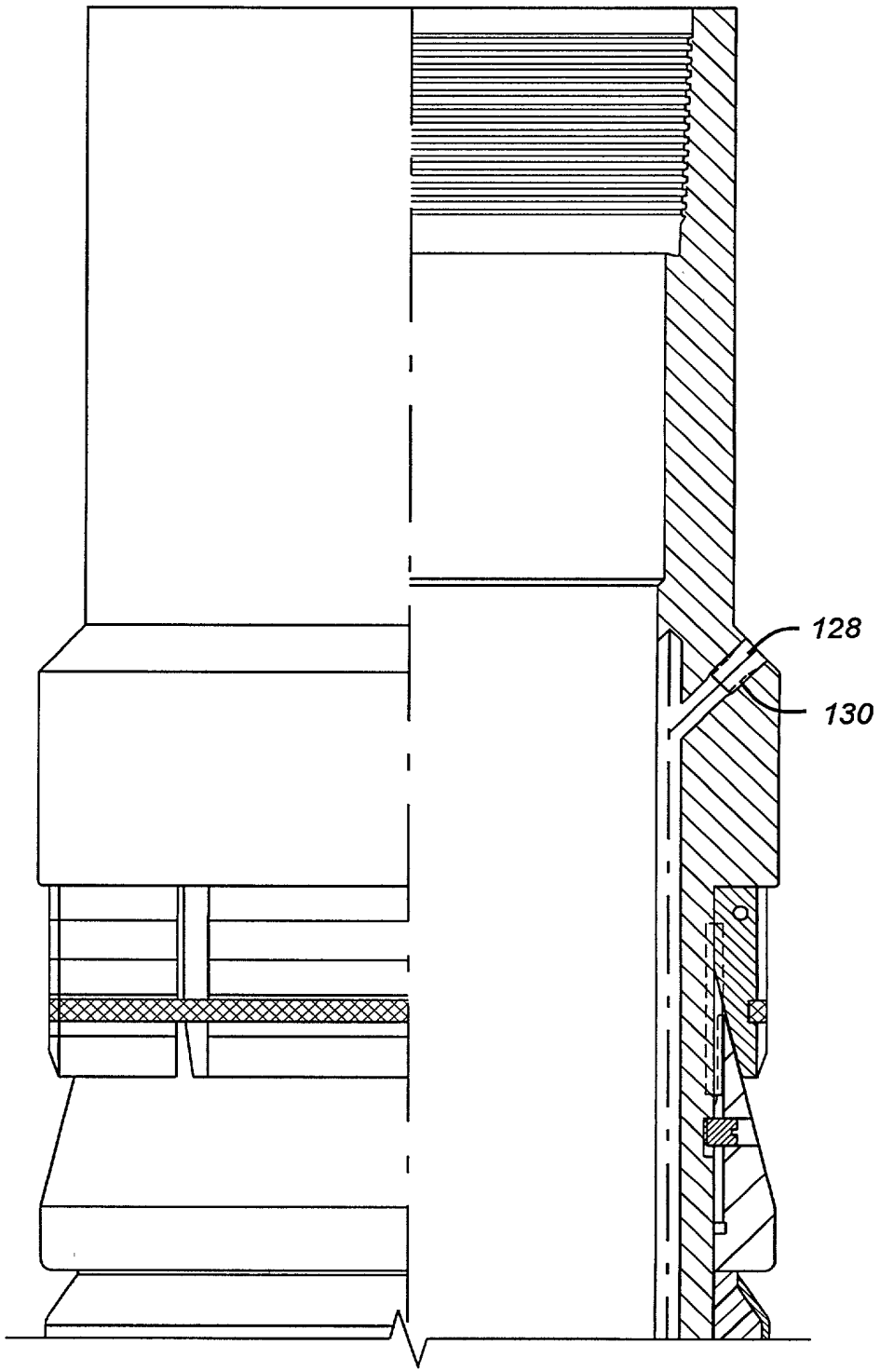


FIG. 3a

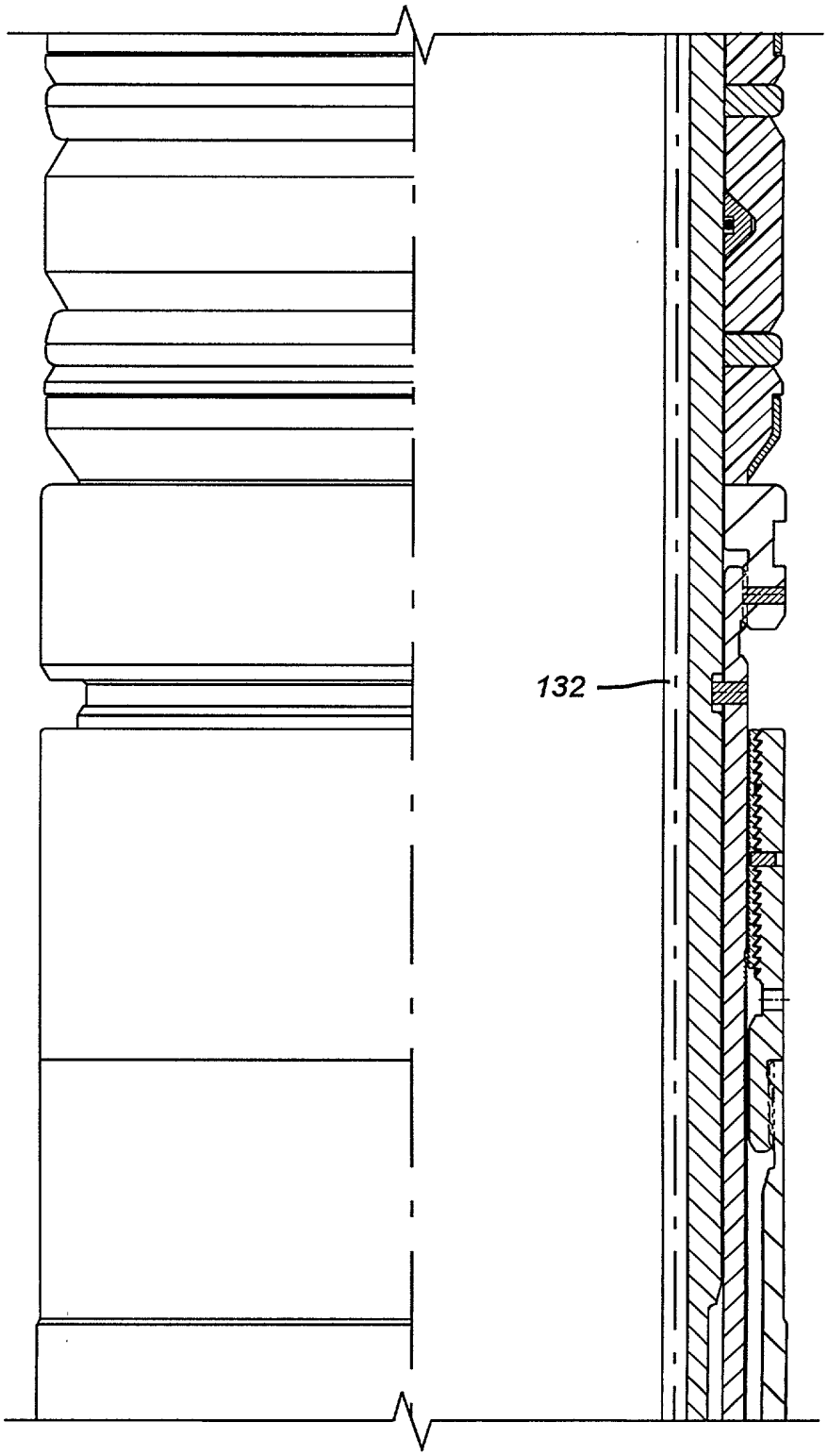


FIG. 3b

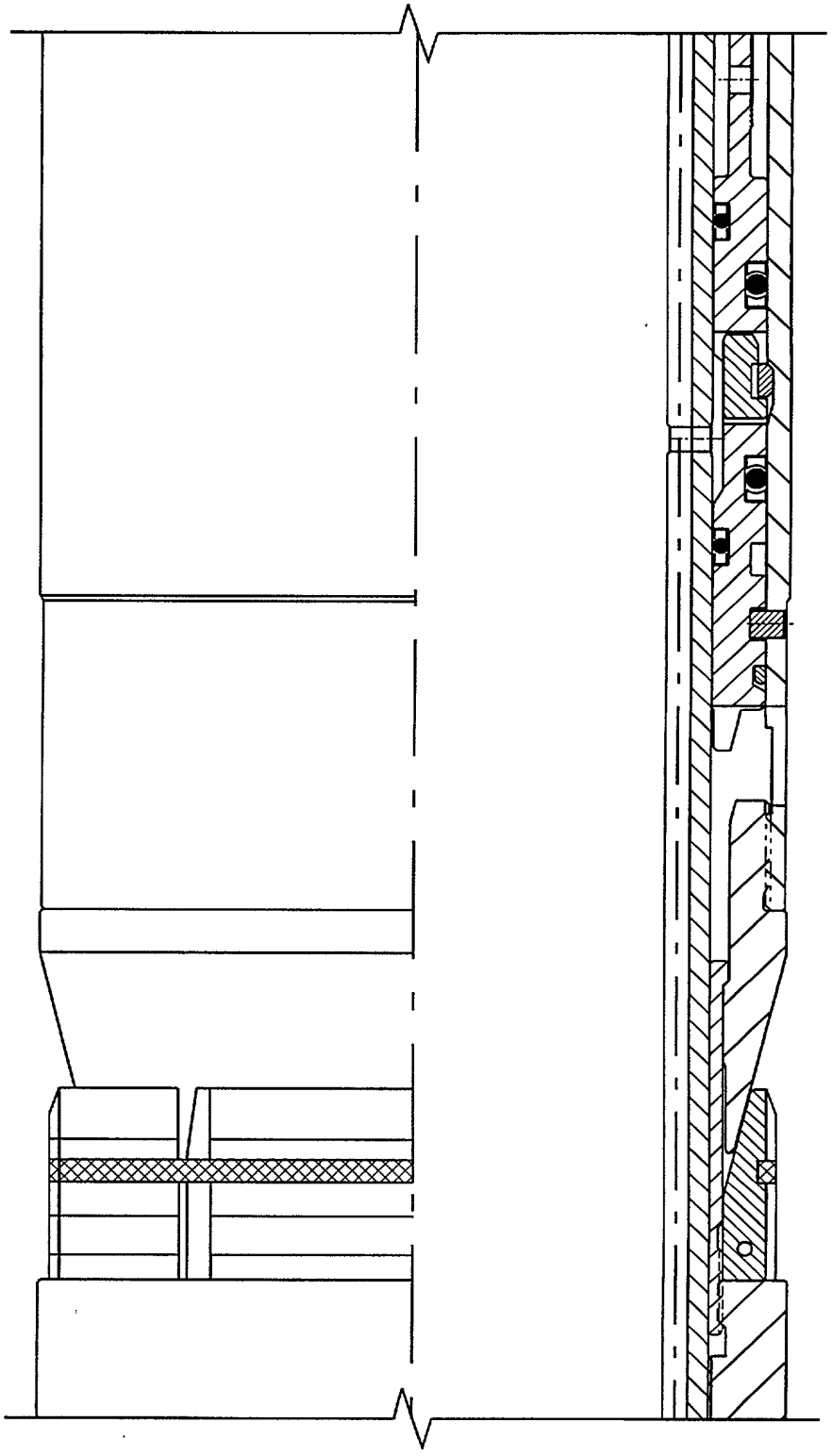


FIG. 3c

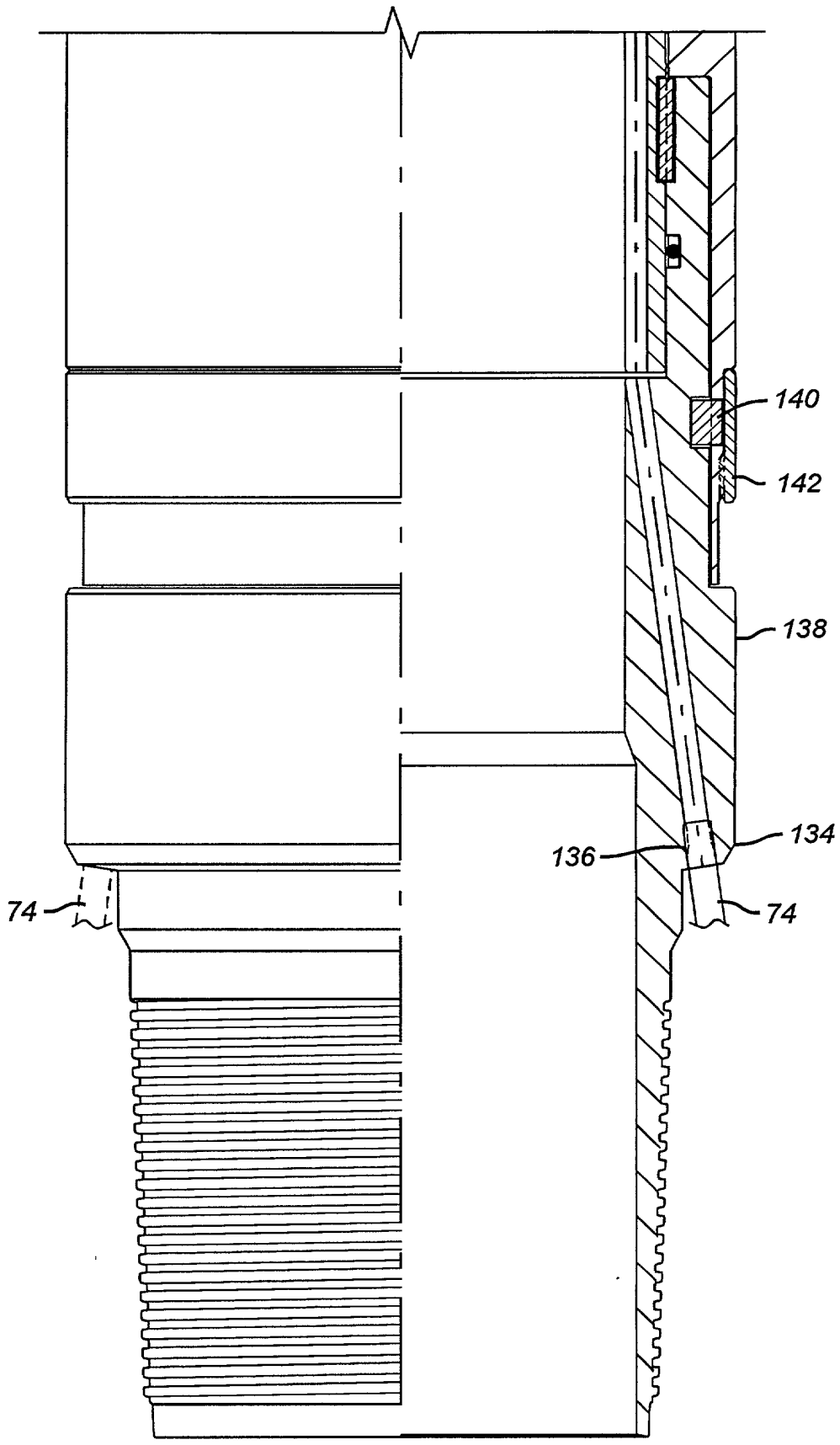


FIG. 3d

COMBINED DECLARATION AND POWER OF ATTORNEY

As the below named inventors, we hereby declare that this declaration is of the following type: ORIGINAL.

Our residences, post office addresses, and citizenships are as stated below next to our names, we believe we are the original, first, and joint inventors of the subject matter which is claimed and for which a patent is sought on the invention entitled: **Downhole Connector for Production Tubing and Control Line and Method**, the specification of which was filed on **January 29, 1999,** as U.S. Serial No **09/239,879.** We hereby state that we have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

We acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. § 1.56.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. § 1.56.

We hereby claim the benefit under Title 35, United States Code, § 119(e) of the United States provisional application number **60/072,934**, filed on **January 29, 1998.**

POWER OF ATTORNEY

As the named inventors, we hereby appoint the following attorneys and/or agents to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

Steve Rosenblatt	Reg. No. 30,799
Carl A. Rowold	Reg. No. 29,023
Matt W. Carson	Reg. No. 33,662
Stephen A. Littlefield	Reg. No. 27,923
Joe Albert Riddle IV	Reg. No. 33,445
Richard T. Redano	Reg. No. 32,292

Direct correspondence and telephone calls to:

Steve Rosenblatt
Rosenblatt & Redano, P.C.
One Greenway Plaza, Suite 500
Houston, Texas 77046
(713) 552-9900

DECLARATION

We hereby declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

FULL NAME AND ADDRESS OF FIRST INVENTOR:

Name: David G. Martin
Residence: VIEWFIELD, MEIKLE WARTLE
INVERURIE, ABERDEENSHIRE, UK
Post Office Address: AB51 5DE
Citizenship: UNITED KINGDOM

8/3/99
Date

Inventor's signature

FULL NAME AND ADDRESS OF SECOND INVENTOR:

Name: Damien Patton
Residence: 44 LORD HAYS GROVE
ABERDEEN, SCOTLAND, UK
Post Office Address: AB24 1WS
Citizenship: IRISH

8/3/99
Date

Inventor's signature

baker\546 decl tt